REMARKS

The Office has maintained the rejection of all claims based upon the same references. Applicant has provided herein further amendments and arguments that clarify the distinctions between the present invention and the cited references. In particular, the claims have been amended for clarity and with certain limitations from the dependent claims. The Applicant respectfully requests that the Office enter these amendments and place the application in condition for allowance or appeal. No new matter is added.

Reliance on Material not in Record

The Office rejects the present claims based in part on the very limited description in the Background section of the cited patent, U.S. Pat. No. 6,818,917 (Kuan) that describes an article in relation to Kuan Figure 7. More specifically, the Office contends that Kuan Figure 7 and the accompanying description by M.Z. Tidrow, K.K. Choi, C.Y. Lee, W.H. Chang, F.J. Towner and J.S. Ahearn in Applied Physics letters, Vol. 64, 1268, 1994, describes a structure similar to the present invention. Applicant does not believe that the Office is correctly interpreting Figure 7, and once again requests that the Office provide a copy of this article in order to assess the scope and accuracy of this paragraph relied upon by the Office.

In particular, the abstract for this article is available and states:

> "A voltage tunable three-color quantum well infrared photodetector (QWIP) consisting of asymmetric GaAs/AlGaAs double quantum wells has been demonstrated. The detector uses electron intersubband transitions in a coupled asymmetric double quantum well superlattice. The infrared photocurrent spectrum characterized using a blackbody monochromator source shows three prominent peaks appearing at 8.4 μm, 9.6 μm, and 10.3 μm under different biases. The three detection peaks are well resolved and can be independently selected by tuning the applied voltage. The responsivity and the detectivity of the detector at different biases and operating temperatures are characterized and found to be sufficient for detector operation at temperatures ~60 K."
> (Abstract from http://www.citeulike.org/user/dalyx/article/682388)

In order to properly understand the article and therefore assess the allegations made by the Office, the Applicant requires a complete copy of the article. The Board of Patent Appeals and

Interferences (BPAI), as well as any reviewing courts, have clearly indicated that findings of fact must be supported by substantial evidence within the record. *In re Gartside*, 203 F.3d 1305, 1315, 53 USPQ2d 1769, 1775 (Fed. Cir. 2000) ("Because our review of the Board's decision is confined to the factual record compiled by the Board . . . the 'substantial evidence' standard is appropriate for our review of Board fact findings. *See* 5 U.S.C. § 706(2)(E).")

Maintaining a rejection based upon the second hand interpretation of the actual article represent a serious gap in the evidentiary record. Relying strictly on the third party interpretation of the article does not allow for an adequate factual finding regarding the teachings of the article, and what is meant to one of ordinary skill in the art. Thus, reviewing parties would not be able to explain the evidentiary basis for subsequent decisions. Efficient prosecution dictates that, when a rejection by the Office is founded on a document that is not in the record, such an article should be provided. The burden is on the examiner to establish a *prima facie* case of obviousness of the claimed subject matter over prior art references. *In re Deuel*, 51 F.3d 1552, 1557, 34 USPQ2d 1210, 1214 (Fed. Cir. 1995). Only after that burden is met must the applicant come forward with arguments or evidence in rebuttal. *Id.* Furthermore, findings of fact must be supported by substantial evidence in the record. *In re Gartside*, 203 F.3d 1305, 1315, 53 USPQ2d 1769, 1775 (Fed. Cir. 2000).

If the Office maintains a rejection based on Kuan Figure 7 and the referenced article therein, Applicant requests that the article be produced and become part of the file history.

Claim Rejections – 35 USC § 103

The Office has rejected claim 1 – 20 as being unpatentable over Martin (U.S. Pat. No. 6,469,358) in view of Kuan (U.S. Pat. No. 6,818,917) and also over Martin in view of Almogy (Monolithic Integration of quantum well infrared photodetector and modulator", Applied Physics Letter, American Institute of Physics). Once again, Applicant does not concede these to be prior art references. However, Applicant has carefully considered the Office rejections and respectfully submits that the amended claims, as supported by the arguments herein, are distinguishable from the cited references.

As a reminder, Applicant includes the applicable section section of the MPEP §2143.01, "[o]bviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found in either the references themselves or in the knowledge generally available to one of ordinary skill in the art." A useful presentation for the proper standard for determining obviousness under 35 USC §103(a) can be illustrated as follows:

1. Determining the scope and contents of the prior art;
2. Ascertaining the differences between the prior art and the claims at issue;
3. Resolving the level of ordinary skill in the pertinent art; and
4. Considering objective evidence present in the application indicating obviousness or unobviousness.

Therefore, obviousness cannot be established by combining prior art references to produce the claimed invention absent some teaching or suggestion supporting the combination. The mere fact that the prior art may be modified in some manner suggested by an examiner upon review of the claims of the present application does not make the modification obvious, unless the prior art suggested the desirability of the modification. The Board of Patent Appeals and Interferences (BPAI) continues to reverse Examiners that can not explain "why a person of ordinary skill in the art would have found it obvious" to combine the references in the manner proposed by the Examiner." Furthermore, the Applicant notes that none of the references specifically recognized the advantages discussed in the present application.

With respect to Kuan, the Office states that this patent describes an asymmetric quantum well structure similar to the present invention. Kuan Figure 7 shows an asymmetric double quantum well superlattice. As described in Kuan Col. 3, beginning on line 55, the quantum wells 72, 73 are coupled by a barrier but "this structure lacks of the design flexibility as the asymmetric quantum well structure." Kuan Figure 7 couples double quantum wells and electronic transitions between different states make multicolor detection possible but they are not similar to the amended claims that include a well spike (see Figure 9a of the present application included herien as compared to Kuan Figure 7).

More specifically, Kuan Figure 7 appears to show a 500 angstrom barrier next to a 72 angstrom quantum well next to a 40 angstrom barrier then a 20 angstrom quantum well and finally another thick barrier. There is no potential barrier well spike having a means for adjusting the ground state of the second quantum well, nor any description as to why such a potential barrier spike would be beneficial.

In addition, the Office refers to Kuan Fig. 10a and 10b and alleges that the superlattice structure described therein is similar to the asymmetric quantum well structure claimed in the present invention. In Kuan Figure 10a and 10b, Kuan describes a bottom superlattice structure (92) with a number of similar 6nm GaAs wells with 4nm AlGaAs barriers. All the quantum wells are the same and are arranged next to each other, and absorb the same frequency.

There is a separating barrier layer (93) and then a top superlattice structure (94) having all 4.5nm GaAs quantum wells with 6nm AlGaAs barriers. The top superlattice also has all the same quantum wells adjacent to each other and intended to all absorb at the same frequency. In more particular detail: (see Kuan, Col. 6, lines 14-39.)

> Please refer to FIG. 10(a), which shows the band structure of our photodetector in accordance with an embodiment of the present invention. The system we described here is belonged to III/V semiconductor materials. The photodetector of the present invention contains sequentially a bottom contact layer 91, preferably is 500 nm, a bottom superlattice 92, preferably is 14-period, a blocking barrier 93, another top superlattice 94, preferably is 14-period, and a top contact layer 95, preferably is 400 nm. Each period of the bottom 92 and top supelattices 94 is respectively composed of 6 nm GaAs well and 4 nm Al.sub.0.27 Ga.sub.0.73 As barrier, and 4.5 nm GaAs well and 6 nm Al.sub.0.31 Ga.sub.0.69 As barrier.

Thus, Kuan describes a group of similar quantum wells for detecting one spectrum in one of the superlattices and another group of quantum wells for detecting another spectrum in the other superlattice structure. They are separated by a separating barrier. Further details of this multicolor photodetector are in the description of Kuan Fig. 10b and Fig. 11.

Kuan does not describe a unit cell having two quantum wells for absorbing two different frequencies wherein they are coupled by a barrier, further including a well spike in the second

quantum well having a means for adjusting the ground state. As already discussed, the well spike is not a coupling barrier such as the barriers in Kuan, but rather is a well spike which is described in the present application as a potential barrier and has a means for adjusting a ground state. The feature of the well spike having a means for adjusting the ground state was previously recited in the prior claims and should not be deemed as new matter requiring a further search.

The Office states the term "spike" is broad, however as described in the present application, the well spike has a means for adjusting a ground state. The term 'well spike' is defined within the present specification and is not to be redefined by the Office to be confused or interpreted as a doping spike. As noted in Paragraph [0067] – "**The well spike of the red well effectively adjusts the ground state, and not the excited states associated with the red well**."

As already described, one aspect of the present invention in relation to the Asymmetric Unit Cell is described in Figure 9a/b as follows: (present specification page 17, Par [0066][0067])

> [0066] FIGS. 9a and 9b illustrate band diagrams, eigenstates, and electron distribution associated with an asymmetric quantum well structure configured in accordance with another embodiment of the present invention. Here, the asymmetric well is provided by virtue of a unit cell that includes two coupled quantum wells. In particular, the design includes a first quantum well configured to absorb a first spectrum (e.g., blue), a second quantum well configured to absorb a second spectrum (e.g., red), and a coupling barrier between the two wells. Outer barriers sandwich the coupled wells, and the second well includes a well spike.
> [0067] The "blue" and "red" wells can be, for example, GaAs. Only the red well is doped. The barriers sandwiching the wells can be, for example, $Al_{.30\%}Ga_{.70\%}As$. The coupling barrier between the wells, and the well spike in the red well can also be $Al_{.30\%}Ga_{.70\%}As$. The well spike of the red well effectively adjusts the ground state, and not the excited states associated with the red well.

Thus, the present invention comprises a unit cell with two adjacent quantum wells, wherein the adjacent quantum wells are not the same – they are photodetectors for two different spectrums. As shown herein for convenience, Fig. 9a of the present invention shows a blue well for absorption of one spectrum and a red well for absorption of another spectrum. The red and blue well is separated by a coupling barrier and is tunable for a spectral response as described in

the specification. This is clearly distinguishable from the Kuan group of quantum wells in the top superlattice all being the same type, and the other group of quantum wells in the bottom superlattice being of the same type wherein a separating barrier separates the two wells. Applicant respectfully requests that the Office acknowledge this aspect.

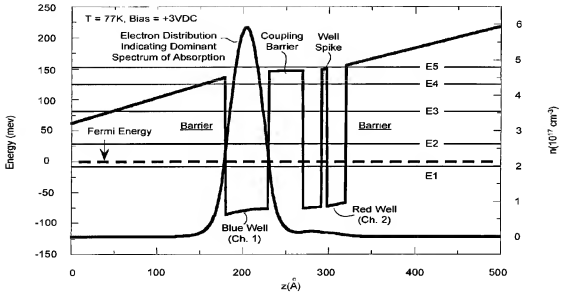

Fig. 9a

Claim 1 has been amended to include the asymmetric quantum well having the unit cell with one quantum well absorbing a first spectrum and another quantum well absorbing another spectrum. The two spectrums are coupled by a barrier layer. And, the well spike is placed in the second quantum well to adjust the ground state. The well spike is not simply a coupling barrier between two quantum wells – there is a coupling barrier between the two quantum wells, and the second quantum well has this additional potential barrier well spike with a means for adjusting the ground state.

The Office alleges that the well spike of the present application is recited in Kuan. More specifically, the Office states that Kuan Fig. 10 depicts well spikes in relation to the 6nm $Al_{.31}Ga_{.69}As$ barriers in the top superlattice. This is incorrect.

A 'well spike' as defined in the present application is a potential barrier and effectively adjusts the ground state and thereby controls the spectral response of the quantum well by controlling the energy levels. As noted in the present application in Par [0067], "[t]he well spike of the red well effectively adjusts the ground state, and not the excited states associated with the red well." It is a potential energy spike and has a large and controllable effect on the energy level of the carriers within the well by adjusting the ground state. This spike can be positive or negative, wherein a positive spike at the well center will raise the ground state energy and move the spectral response to a longer wavelength, and wherein a negative spike at the well center will lower the ground state energy and move the spectral response to a shorter wavelength.

This is not equivalent to the barrier referred to in Kuan. Applicant directs the Office to read the description of Kuan Fig. 10(a) located in Col. 6, lines 14-39. The blocking barrier layer of Kuan, including the 6nm $Al_{.31}Ga_{.69}As$ barriers in the top superlattice – are barrier layers – they are not potential barriers (well spikes) that alter the ground state.

The Office also alleges that Almogy describes the well spike of doped material is related to the well spikes as defined in the present application. This is incorrect.

As already presented to the Office - there is nothing in Almogy that is functionally related to the potential barrier well spike of the present invention. The Almogy reference is related to a doping spike which refers to a technique to provide electrons to the quantum wells and is a doping technique for providing charge carriers like electrons or holes. This doping technique is a method of confining donor/acceptor impurity atoms to an atomic layer of a host crystal.

In contrast, the well spike of the present invention resides in the second quantum well and includes a means for adjusting the ground state of the well. There are no prior art potential barrier well spikes as described in the present application that have a means for adjusting the ground state.

The Office states that "there is a well spike in Almogy and any functional language such as "adjusts" does not structurally distinguish the claims over the applied art because the well spike along with the other well structure determines the ground state of the well." (Office Action page 4) As already explained, the term "well spike" is shown in Figure 9a, 9b of the present invention and described in the present application. The Applicant's definition should be applied, and is not remotely related to the doping spikes of Almogy.

Almogy describes external biasing (see Almogy page 1088 and FIG. 1(a)) and there is no 'well spike' that adjusts the ground state in Almogy nor any description of any structure that adjusts the ground state. Almogy FIG. 1(a) shows two quantum wells coupled by a barrier – there is no additional well spike in the second quantum well that adjusts the ground state. If the Office wishes to maintain this rejection, the Applicant requests that the Office locate the section in Almogy that supports the allegations by the Office. Reconsideration and allowance is requested.

The present invention also differs from the cited art by depositing thin detector layers, stacking the layers vertically on top of each other, by applying a refractive grid finish to the backside contact layer and a further reflective finish to the backside and edges to create the photon box, and by bringing the bias contact as well as the readout contacts to the backside surface of the pixel for mating to the ROIC substrate as with flip-chip or other bonding techniques. Vertically stacking relatively thin detector layers in order of transparency, and using the refractive grid and associated "photon box" techniques, allows each detector the maximum exposure area to the incoming light. This improves the detector fill factor, here defined as the active optical detector area divided by the total area, and also the detector performance. None of the other references, alone or in combination, include the features recited in the independent claims 1, 11, and 16. Reconsideration and allowance of all claims is respectfully requested.

Telephone Interview

Applicant respectfully requests a Telephone Interview at the earliest convenience of the Office. Please call the undersigned attorney at 603.886.6100 to schedule such an Interview as the Applicant believes that such a discussion will resolve any remaining issues and result in allowance.

Applicant believes the above amendments and remarks to be fully responsive to the Office Action, thereby placing this application in condition for allowance. No new matter is added. Applicant requests speedy reconsideration, and further requests that Examiner contact its attorney by telephone, facsimile, or email for quickest resolution.

Respectfully submitted,

/Scott J. Asmus, Reg. No. 42,269/

Cus. No. 42716
Maine & Asmus
PO Box 3445
Nashua, NH 03061-3445
Tel. No. (603) 886-6100, Fax. No. (603) 886-4796
patents@maineandasmus.com

Scott J. Asmus, Reg. No. 42,269
Andrew P. Cernota, Reg. No. 52,711
Attorneys/Agents for Applicant